

ARCHIVER (João Fernandes, Jakub Urban) **(new)**

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CDI (Antti  
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**(new)**

OPENAIRE AMKE (Iryna Kuchma, Elli  
Papadopoulou) **(new)**

### 11 May Pillar 1: Concepts for FAIR implementation

Concepts  
for FAIR  
implementat  
ion (Pillar 1)

Rec. 1:  
define FAIR  
for  
implementat  
ion

Data Management Plans for project and resuting R&D services: <https://doi.org/10.5281/zenodo.3600421> using the “Practical Guide to International Alignment of Research Data Management” from Science Europe ( <https://www.scienceeurope.org/our-resources/practical-guide-to-the-international-alignment-of-research-data-management/> ).

FAIR implementation work is reflected on the three pillars that OpenAIRE operates: policy-services-training. - Model policy documents that OpenAIRE has prepared address FAIR principles in their context and are used by NOADs who communicate Open Science and EOSC updates on their institutions, national research funders and other research performing organizations (<https://www.openaire.eu/openaire-releases-model-templates-and-checklists-for-policy-makers> ). - RDM resources (<https://www.openaire.eu/grassroots-in-research-data-management-the-impact-of-the-openaire-task-force-rdm>) and training material developed by OpenAIRE members/organizations support a variety of FAIR aspects and guide their implementation. - Services such as PROVIDE (repository network) explicitly address interoperability of the FAIR principles. The OpenAIRE Guidelines that PROVIDE uses are adpated to include FAIR aspects, and we are enhancing the validator to make a lightweight FAIR assessor (compliant to RDA FAIR Maturity Model). New services such as Argos for machine actionable DMPs are being developed. Also, the Research Graph (open scientific knowledge graph) collects information from Open and FAIR ecosystems globally (outputs, semantics, PIDs, metadata,

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<div>Rec. 2: Implement a model for FAIR digital objects</div> <div>Rec. 3: develop components of a FAIR ecosystem</div> <div>Rec. 16: Apply FAIR broadly</div>		Support of tools for search, look up or filter potential datasets rapidly, to access dataset metadata and decide on its relevance (e.g. citation purposes or reusing a dataset). Automated metadata indexing for several tens of PB content must be standard, aiming at maximum interoperability, including support for dataset filtering. Access and permission management against repositories and various collections supporting Federated Identity and Access Management. Fast information tagging and indexing for PB of data (easy and broader search, as a strategy to promote open data access).			etc) and exploits them to inform about the evolution of Open Science. OpenAIRE in collaboration with La Referencia are approaching repositories enhancements with the scope of creating FAIR digital objects. Use of Argos DMP tool supports links between Argos DMP machine actionable outputs and other entities included in the OpenAIRE Research Graph, e.g. funders, repositories, datasets, metadata etc
		Prototype demonstrators of full reproducibility of services (initial examples are database services and/or software distribution services) on top of the resulting supported data archives. Ability to run additional scientific analyses independently of on-prem infrastructure in stages. For example: (i) Run scientific software distribution services on-premise of the Buyers organisations relying on storage services provided externally by the commercial service provider, in hybrid mode, (ii) Run scientific software distribution services reproduced externally, relying on storage services provided by the commercial service providers.			The Research Graph is populated with scientific information that is contextualised to create research entities, such as those addressed by the recommendation. In particular, Argos machine actionable DMP outputs enhance the OpenAIRE Research Graph and create links with other outputs and relationships (semantics). <a href="https://argos.openaire.eu/splash/about/how-it-works.html">https://argos.openaire.eu/splash/about/how-it-works.html</a>
		Setup of an early adopters programme: <a href="https://archiver-project.eu/early-adopters-programme">https://archiver-project.eu/early-adopters-programme</a>			- To close the DMP lifecycle and publish DMP outputs that apply open and FAIR principles, Argos machine actionable DMP tool integrated with Zenodo.- DMPs uptake, as well as other research entities that are in the Research Graph, including their openness and FAIRness, are measured via OpenAIRE

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	Rec. 17: Align and harmonise FAIR and Open data policy	<p>“As Open as possible, as closed as necessary” is how the EC defines it. Considering the work being done several communities in this topic, some references related to FAIR definitions can be found in the following links: <a href="https://www.force11.org/group/fairgroup/fairprinciples">https://www.force11.org/group/fairgroup/fairprinciples</a> It defines what FAIR means, with a set of specific definitions relevant to each term. <a href="https://www.rd-alliance.org/system/files/FAIR%20Data%20Maturity%20Model%20Specification%20and%20Guidelines_v1.00.pdf">https://www.rd-alliance.org/system/files/FAIR%20Data%20Maturity%20Model%20Specification%20and%20Guidelines_v1.00.pdf</a> (table 4.1, page 11) It contains detailed guidelines for assessing the FAIRness of a dataset. "FAIR != Open". FAIR should start early in the research data management (RDM) life cycle. This is being advocated by some of the members of the Buyers Group for years (e.g. one positive reaction from a digital repository conference: <a href="https://twitter.com/InesDrefs/status/1139100217171726336">https://twitter.com/InesDrefs/status/1139100217171726336</a>)</p> <p>Practical guideline being used by the ARCHIVER project and included use cases for the set of requirements for data management plans (DMPs), as well as a list of criteria for the selection of trustworthy repositories where researchers can store their data for sharing: <a href="https://www.scienceeurope.org/our-resources/practical-guide-to-the-international-alignment-of-research-data-management/">https://www.scienceeurope.org/our-resources/practical-guide-to-the-international-alignment-of-research-data-management/</a></p> <p>The ARCHIVER project does not intend to “re-invent” any additional definition of Open Data. Instead, considering all of the above, please find below some of the specific aspects of the datasets and scientific domains</p>			<p>MONITOR dashboards and the Open Science Observatory.- FAIR aspects are part of the model policy templates of OpenAIRE aimed at adopting Open Science policies at institutions This is a core activity of OpenAIRE and has been since the very beginning (10 years ago) when OpenAIRE was called to support Open Access / Open Science strategies of the European Commission. OpenAIRE has since grown to meet policy needs of additional national research funders and other academic and research stakeholders. OpenAIRE satisfies this recommendation on practical level via its strong infrastructure and on policy level via the human network of NOADs (National Open Access Desks).</p>

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represented by the Buyer Group: The essential is not that the data is Open, but that FAIRness is clearly defined, agreed and that the Buyers Group organisations are able to control it.

For example, from the 2nd link above (RDA-A1.2-01D):

"Data is accessible through an access protocol that supports authentication and authorisation". This is considered a key element since without that, organisations cannot embargo data during publication. After publication, the data can be moved out from the authentication and authorisation layer and make the data open, but data cannot be always open with no ability to secure access. In the Life Sciences domain for example, much of the data is fully open, and in the ARCHIVER project, an assessment of the access controls using that data will be done, simulating the restrictions. In High Energy Physics, the CERN Open Data service, as an use case involved in ARCHIVER, the content is fully open in the sense of the Open Knowledge Foundation, i.e. "without any legal, technological or social restriction", no registration needed, etc.: <https://okfn.org/opendata/>.

However, the research data are born naturally "closed" within the given experimental team. One should strive to make them FAIR early enough to ensure knowledge sharing and reusability/reproducibility. Typical problem: a PhD student works on a complicated analysis, defends the thesis and leaves physics to work in a data science field in the private sector. Is his former supervisor or anybody else from the team able to reproduce and continue the student's work one year later? For this purpose, CERN is running a sister project, the CERN Analysis Preservation service -- which is not part of the ARCHIVER use cases -- and where the goal is exactly to

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preserve "closed" code and data from LHC collaborations and make them as findable and reusable as possible -- strictly within a given restricted experimental team. The collaboration can, after some embargo period, decide to publish some parts of that data as "truly open" on the CERN Open Data portal, should they wish so. To ensure data reusability, CERN is running a third sister project, the REANA Reproducible Analysis platform. This focuses fully on the "R" part of FAIR, taking advantage of container technologies to encapsulate data analysis workflows to ensure data reusability. This applies just as well to "closed data" (CERN Analysis Preservation) as to its "open" counterparts (CERN Open Data). In case of interest in more details, here are two opinion pieces on the CERN Open Data, the CERN Analysis Preservation and the REANA Reproducible Analyses trio:

<https://cerncourier.com/a/open-science-a-vision-for-collaborative-reproducible-and-reusable-research/>  
<https://www.nature.com/articles/s41567-018-0342-2>

In Photon-Neutron sciences, most labs are following the PaNData data policy with some adjustments, also touching the Open Data/Open Access - actually the term 'Open Access' is used interchangeably. The EuXFEL defines it as: "The term open access shall mean the generally unrestricted (but not anonymous) and free-of-charge access and use for the academic community. With respect to the European XFEL GmbH, open access shall mean that data will be published under CC-BY". CC-BY is the Creative Commons BY:

<http://creativecommons.org/licenses/by/4.0/legalcode>

To put it simple - in contrast to a public web site, the following "added features" are required: - Embargo period (0-N years - 0 means no period)- Addressing

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(identifying) data through persistent identifiers (PID) (not filenames) - pointing to the dataset.- Prior to access the data - this has to be requested and explicitly granted (might be a NULL operation if not applicable and access granted immediately) - Maintain a protocol: Who, When, What Finally, considering the Astrophysics domain, there is an additional modality which will gain importance in coming years. There is no label for it yet, for the purposes of this definition one can call it "Open Discovery with Access upon Registration". The idea is simple: there should be enough metadata available in a completely open manner (i.e. without any Registration/Authorisation or even Authentication) to be able to Discover that a dataset exists. An example from Astronomy could be "Observations of the Crab Nebula during August of 2015": this could return a list of observations that were made by different telescopes in different wavelengths during that period of time. As a next step, a particular user may want to access some of these data and do some analysis. In order to do so, they would need to register and/or authenticate, fulfilling the aforementioned point about a protocol for access (Who, When, What). This would ease the Findability of data, and is compatible with the Accessible of FAIR, often wrongly interpreted as "Accessible without any traceability".

## 19 May Pillar 2: FAIR culture

Rec. 4:  
Develop  
interoperability  
frameworks

A detailed gap analysis shows support for open standards such as PREMIS, METS or BagIt, but as well considerable limitations and drawbacks including focus on text documents, images or other small files rather than large opaque computational data sets. Interfaces

Interoperability is important for EUDAT CDI. The

OpenAIRE Guidelines for Data Archives enable repositories' interoperability on the level of metadata and the Broker that has been built ensures that metadata are enhanced when additional information can be

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<p>are optimized for manual workflows rather than continuous automatic ingestion pipelines, limited capabilities for scaling the metadata extraction and other pre-ingestion microservices. R&amp;D being produced to support: arbitrary size standards compliant archive-packages in a cost-effective manner (Layer 1): no large storage required anymore for archive preparation. • Adds OpenFaaS serverless functions for scalable metadata extraction with containers (Kubernetes), metadata-based data discovery and support for long running asynchronous tasks and autoscaling features. (Layer 2/3) • Adds Flowable for automated coordination of archiving workflows; (Layer 2/3) • Onedata plugin to Archivematica, allows automatic archive ingestion from Onedata spaces; (Layer 3/4) • Onedata provides open data functionality for Metadata management. Data discovery, OAI-PMH interface and DOI and PID minting. (Layer 3/4) • Supports Kubernetes, as the main deployment framework for the proposed platform for automated independent deployment at scale (Layer 4). • Kubernetes allows flexible platform configuration through Helm Charts, extensive modularization through Pods and allowing easy file system sharing between containers (Layer 4).</p>		<p>EUDAT Service portfolio includes several interoperable services. EUDAT also follows EOSC developments on the area and aims to improve on this area as well. A recent update is that EUDAT B2FIND and B2SHARE metadata schema has been updated in the root metadata schema definition which now takes in all</p>	<p>provided from the +17.000 harvested and deduplicated resources of OpenAIRE. <a href="https://guidelines.openaire.eu/en/latest/data/index.html">https://guidelines.openaire.eu/en/latest/data/index.html</a></p>

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metadata fields from DataCite metadata schema definition v4.3, improved support for multiple root schema versions and an updated and improved metadata exporter via OAI-PMH protocol.

Rec. 5:  
Ensure data management via DMPs

Adopting the “Practical Guide to International Alignment of Research Data Management” from Science Europe ( <https://www.scienceeurope.org/our-resources/practical-guide-to-the-international-alignment-of-research-data-management/> ).

ARGOS DMP tool <https://argos.openaire.eu>, guides: <https://www.openaire.eu/guides> and training activities. - For Argos: it applied RDA DMP standard to argos so DMPs are machine actionable. Working on disciplinary aspects with a couple of research communities to implement Domain Data Protocols - DDPs. Worked with ARIADNE Plus to complement each other's work and developed a machine actionable DMP instance for archaeological data. Working with other projects representing research communities such as



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Rec. 6: recognise & reward FAIR data & stewardship				NEANIAS also (hydrology, and other domains). Have been approached by publishers to bridge data availability statements and dmeps. The aim has been to help close the dmp publication lifecycle through integration with Zenodo (and other repos in the future). Also working with funders such as CHIST-ERA and FCT.- Collection of 841 publicly available Horizon 2020 Data Management Plans in Phaidra, the repository of the University Vienna (by Daniel Spichtinger and Gerda McNeill) <a href="https://phaidra.univie.ac.at/detail/o:1140797">https://phaidra.univie.ac.at/detail/o:1140797</a> Open Science policy templates include rewards and incentives for FAIR data & stewardship: <a href="https://www.openaire.eu/toolkit-for-policy-makers-on-open-science-and-open-access">https://www.openaire.eu/toolkit-for-policy-makers-on-open-science-and-open-access</a> . This is also one of the things that NOADs communicate to national academic and research stakeholders in their attempts to influence policymaking. Moreover, it is a topic that - should the circumstances allow - they include in the national policies / plans that they help Ministries with drafting or they draft themselves as proposals to the corresponding Ministries. The graph and the monitor services work towards this direction: to be used by individuals and institutions to assess their openness.
	Rec. 18: Cost data management	The ARCHIVER contractors have a deliverable describing the cost effectiveness factor as part of the decision making for the solution architecture of a petabyte scale system (e.g. optimised ingest workflows, improvement of		

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	Rec. 19: Select and prioritise FAIR digital objects	FOSS components, combination of different storage tiers, flexibility of the deployment model, data movement options, etc.). It shall include all aspects of the architecture that influence the future cost effectiveness of the resulting services. The Buyers Group does not expect this initial version of the TCS to include costs broken down for each use case. A demonstration with an example use case may be requested in versions of the document for the next phases of the project. The Buyers Group invites the Contractors to consider using the qualitative and quantitative factors described in the ECAR framework <sup>1</sup> , in order to structure the description. Support of High level of redundancy, strong disaster recovery mechanisms, long-term planning for decades and active monitoring of data integrity in order to detect unwanted changes such as file corruption or loss. Best practices foreseen in CoreTrustSeal in terms of self-assessment. Support for handling unstructured and missing metadata. OSS components and vendor independent standards and interfaces (such as PREMIS, METS and Bagit) are preferred to allow implementation and demonstration during the Prototype and Pilot of exit strategies to prevent vendor lock-ins. Support of tools for search, look up or filter potential datasets rapidly, to access dataset metadata and decide on its relevance (e.g. citation purposes or reusing a dataset). Automated metadata indexing for several tens of PB content must be standard, aiming at maximum interoperability, including support for dataset filtering. Access and permission management against repositories and various collections supporting Federated Identity and Access Management. Fast information tagging and indexing for			trainings and relevant activities. Examples include: What will it cost to manage and share my data? (Ryan O'Connor, Sarah Jones and Alexandra Delipalta): <a href="https://www.openaire.eu/rdm-researcher-costs-infographic/view-document">https://www.openaire.eu/rdm-researcher-costs-infographic/view-document</a> , How to identify and assess Research Data Management (RDM) costs <a href="https://www.openaire.eu/how-to-comply-to-h2020-mandates-rdm-costs">https://www.openaire.eu/how-to-comply-to-h2020-mandates-rdm-costs</a>
					Support with outreach to MSCA programmes. (MSCA: <a href="https://ec.europa.eu/programmes/horizon2020/en/h2020-section/marie-sklodowska-curie-actions">https://ec.europa.eu/programmes/horizon2020/en/h2020-section/marie-sklodowska-curie-actions</a> )

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	Rec. 20: Deposit in Trusted Digital Repositories	<p>PB of data(easy and broader search, as a strategy to promote open data access).</p> <p>TDrs developed have a deliverable that is a description the cost effectiveness factor as part of the decision making for the solution architecture of a petabyte scale system (e.g. optimised ingest workflows, improvement of FOSS components, combination of different storage tiers, flexibility of the deployment model, data movement options, etc.). It shall include all aspects of the architecture that influence the future cost effectiveness of the resulting services. The Buyers Group does not expect this initial version of the TCS to include costs broken down for each use case. A demonstration with an example use case may be requested in versions of the document for the next phases of the project. The Buyers Group invites the Contractors to consider using the qualitative and quantitative factors described in the ECAR framework1, in order to structure the description.</p>	DICE includes a task for long-term preservation on that will work on drafting a strategy for LTP of EUDAT services.		OpenAIRE VALIDATOR allows for repositories that are part of the OpenAIRE network to be certified on their metadata quality and completeness by checking metadata they expose against the OpenAIRE guidelines. <a href="https://www.openaire.eu/validator/">https://www.openaire.eu/validator/</a>
	Rec. 21: Incentivise reuse of FAIR outputs	<p>Container Orchestration engine support based on Kubernetes for the compute capabilities to allow scientific analyses to be carried out off-prem. Interfaces from infrastructure layer integrated on the overall design (allow access to data, no matter where stored);</p>			In Argos, we try to normalise the different types of data and the criteria for reuse. e.g. for sensitive data trying to understand what researchers and funders need to know. Argos draws information from the OpenAIRE API and creates links with different research entities and outputs included in the OpenAIRE Research Graph. Introduced a reused data section in some templates (eg Science Europe, CHIST-ERA and H2020) with fields that gather information relevant for data that are being reused in the research, e.g. link to corresponding DMPs (if any, to help with providing additional information), data repositories to know where reused data

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					resides/ are preserved, PIDs/name of datasets to know which particular datasets from those repositories are being reused etc.
<b>20 May Pillar 3: FAIR Ecosystem</b>					
<b>FAIR ecosystem (Pillar 3)</b>	<b>Rec. 7:</b> support semantic technologies <b>Rec. 8:</b> Facilitate automated processing  <b>Rec. 9:</b> Certify FAIR services	<p>Prototype demonstrators of full reproducibility of services (initial examples are database services and/or software distribution services) on top of the resulting supported data archives. Ability to run additional scientific analyses independently of on-prem infrastructure in stages. For example: (i) Run scientific software distribution services on-premise of the Buyers organisations relying on storage services provided externally by the commercial service provider, in hybrid mode, (ii) Run scientific software distribution services reproduced externally, relying on storage services provided by the commercial service providers.</p> <p>Pilot phase objective is to have the ARCHIVER resulting services as CoreTrustSeal certified TDRs. The ARCHIVER contractors shall deliver a description detailing the level of support the future solution will provide on the set of data stewardship responsibilities the Buyers Group (BG) organisations have for preservation and access to data for a designated research community. The BG organisations will require concrete support from the future ARCHIVER resulting services in aspects such as information package management, preservation planning, workflow configurations, etc. It shall also describe a concrete mapping of the technical and</p>			
		<p>OpenAIRE is built on the Research Graph, an open scholarship Linked Open Data environment.  <a href="https://zenodo.org/record/2643199#.YKv7NggzY2w">https://zenodo.org/record/2643199#.YKv7NggzY2w</a>          Argos, automating processes relating to DMPs, e.g. repositories are notified to expect a large dataset. Also, working on aligning existing OpenAIRE guidelines against FAIR criteria.</p> <p>By following the OpenAIRE Guidelines, repositories are inevitably called to put in place processes and to embed services that allow for their indexed content to be FAIR, even in its minimum interpretation (eg with metadata standards, PIDs, etc)</p>			

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organisational measures to be supported by the resulting Design against ISO16363 and CoreTrustSeal certification schemes and/or service capabilities as foreseen in maturity models such as DPC RAM2. The BG shall be able to measure the level of support on those assessments, taking into account a realistic balance between real world multidisciplinary petabyte experimental data management and certification schemes.

Rec. 22:  
Use  
information  
held in  
DMPs

Rec. 23:  
Develop  
components  
to meet  
research  
needs  
Rec. 24:  
Incentivise  
research  
infrastructur  
es to

Argos progressively integrates with other OpenAIRE services, namely MONITOR dashboards and Usage Counts, to define indicators and deliver statistics to academic and research stakeholders in support of informed decisionmaking. Argos also integrates with the Research Graph and undertake a first set of validations of which datasets are included in which DMPs, which datasets are reused and which DMPs are written for which project.

<https://repository.publisso.de/resource/fri:6424230/data>

National OpenAIRE workshops promote conversations between different stakeholders

Via the research community standards and Argos DDP implementation

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support  
FAIR data

## 18 May Pillar 4: Skills for FAIR

Skills for  
FAIR (Pillar  
4)

Rec. 10:  
Professional  
ise data  
science &  
stewardship  
roles  
Rec. 11:  
Implement  
curriculum  
frameworks  
and training

The activities take place at a national or institutional level. OpenAire provide a Community of Practice of Training Coordinators <https://www.openaire.eu/cop-training>

Institutional and national training and train-the-trainer programmes , embedding skills and training in open science policies, FAIRsFAIR/OpenAIRE workshop National policy and support actions for research data skills - impact and experiences <https://www.fairsfair.eu/events/national-policy-and-support-actions-research-data-skills-impact-and-experiences-0>

## 12 May Pillar 5: Incentives and metrics for FAIR data and services

Incentives  
and  
metrics for  
FAIR data  
and  
services  
(Pillar 5)

Rec. 12:  
Develop  
metrics for  
FAIR digital  
output  
Rec. 13:  
Develop  
metrics to  
certify FAIR  
services

Assessment and integration of FAIRsFAIR FUJI-tool against datasets and repositories.

Via MONITOR <https://monitor.openaire.eu/> and the Open Science Observatory

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	Rec. 25: Implement and monitor metrics	Help Improving FUJI-tool findings (eliminating false positives and adapt it to use cases such as the CERN Open Data Portal JSONs, taking in consideration for example custom metadata from scientific datasets (e.g Physics) at a certain scale (8k records per dataset) and apply F-UJI scores to TDR assessments. Investigate the use BagIt, BDBag, or RO-Crate as alternative input sources for F-UJI to start the analysis from, instead of always starting from landing pages.			Via MONITOR and the Open Science Observatory
	Rec. 26: Support data citation and next generation metrics				Via Zenodo, Datacite
21 May Pillar 6: Investment in FAIR					
Investment in FAIR (Pillar 6)	Rec. 14: Provide strategic and coordinated funding	Model proposed by ARCHIVER to the EOSC Future project with a sustainable model to procure the ARCHIVER resulting services and to address concerns raised by the EC by delivering sustainable, production quality long-term data preservation services for user communities that fill a gap in the existing EOSC portfolio, extending the scope to accommodate diverse use-cases, including small-scale deployments requiring TB range preservation capacity.			OpenAIRE supports participatory research in many ways. Most recent is the open innovation calls for the co-creation of new Open Science services and enhancement of existing OpenAIRE services and tools. <a href="https://www.openaire.eu/open-innovation-in-openaire">https://www.openaire.eu/open-innovation-in-openaire</a>
	Rec. 15: provide sustainable funding	Clear breakdown of responsibilities between Service Provider and Data Stewards (ARCHIVER RPOs); FAIR considered in the outset. Commodisation of FAIR for research organisations. Sustainable model being designed from day 1 of ARCHIVER: 1) Broad pan-European requirement analysis of the research sector Analysis results considered in the competitive R&D			Since 2018, OpenAIRE is a legal entity. OpenAIRE being the largest community-driven open scholarly communication infrastructure, adapts more sustainable models of funding that ensures effectiveness of its operations at all levels.

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Rec. 27:  
Open  
EOSC to all  
providers  
but ensure  
services are  
FAIR

tender Technical and organisational measures aligned with European legislation in the services being developed (by default & by design) 2) Early Adopters Programme established Additional use cases expanding further the set of supported scientific domains Publicly funded research actors external to the ARCHIVER consortium 3) Model for facilitate procurement of sustainable pilot services For consortium members and Early Adopter organisations, beyond the lifetime of the project Model proposed by ARCHIVER to the EOSC Future project with a sustainable model to procure the ARCHIVER resulting services and to address concerns raised by the EC by delivering sustainable, production quality long-term data preservation services for user communities that fill a gap in the existing EOSC portfolio, extending the scope to accommodate diverse use-cases, including small-scale deployments requiring TB range preservation capacity.